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13. ABSTRACT (Maximum 200 words)  During the period between February 1, 1989 and September 30, 1992, the U.S. Army grant, number DAAL03-89-K-0057, has funded auroral and airglow analysis of the ECOM-721 Extreme Ultraviolet Spectrometer Data. Some of the important work that we accomplished with the support of this grant includes transferring the data to a more accessible storage format, creating a quick look archive, further development of a solar EUV flux model which is crucial to the ECOM airglow analyses, development of a spherical radiative transfer model, and the analysis of atomic nitrogen dayglow as well as proton aurora STP78-1 data.					
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## Final Report for Army Grant #DAAL03-89-K-00578

During the period between February 1, 1989 and September 30, 1992, the U.S. Army grant, number DAAL03-89-K-0057, has funded auroral and airglow analysis of the ECOM-721 Extreme Ultraviolet Spectrometer Data. The instrument flew for about 9 months and acquired several hundred thousand extreme and far ultraviolet (EUV and FUV) spectra of the Earth's dayglow. Up until 1989, only a small fraction of the data had been analyzed. The purpose of this grant, is, as the title indicates, the further analysis of this large data set. The specific problems that were addressed are listed presently:

1. Access to the data. The data was initially stored on several hundred reels of 1/4 inch magnetic tape. Access to the data was unruly and time consuming.
2. Inadequate solar EUV flux. In order to model the airglow and auroral emissions adequately, one must know the solar EUV flux between 250 and 1150 Å. Although the Atmospheric Explorer satellite, AE-E, measured the solar flux at the same time that the STP78-1 satellite was in orbit, there is some controversy as to the accuracy of its EUV measurements between 50-575 Å. An appropriate model is needed which makes use of other solar flux measurements. This model is also important in the analysis of other data taken during the time while there were no EUV solar flux measurements. These data are in comparison studies with the ECOM data.
3. Proton aurora. Energetics and mechanisms involved in the production of hydrogen emission at Lyman  $\alpha$  are not well understood. The data from several orbits contained proton aurora signatures.
4. Spherical Radiative Transfer (SRT). In order to model important hydrogen and helium resonant lines, HeI 584Å, HI 1216Å, one must have a radiative transfer model employing spherical geometry.
5. Atomic nitrogen emissions. Until recently, the NI 1134 and 1200 Å lines in the ECOM spectra have not been analyzed.

## Summary of Important Results

Some of the important work that we accomplished with the support of this grant include transferring the data to a more accessible storage format, creating a quick look archive, further development of a solar EUV flux model which is crucial to the ECOM airglow analyses,

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development of a spherical radiative transfer model, and the analysis of atomic nitrogen dayglow as well as proton aurora STP78-1 data. The relevant publications, abstracts as well as the personnel involved are listed in the next sections. Below, we briefly describe each project.

Two projects were implemented to make the ECOM data base more manageable and accessible: archiving the data to optical disk media and creating a quick look archive which would allow one to scan the data for certain characteristics. They were performed simultaneously, by a series of undergraduate students.

Dr. Kent Tobiska revised and extended his solar EUV flux model, SERF2, with the support of this grant. It has been extended in the timeframe in which it can be used from October 1981–April 1989 to 1947–present for coronal EUV full-disk irradiances and 1976–present for chromospheric EUV full-disk irradiances. Substantial revisions were made which significantly improve the ability of the model to reproduce the 27-day solar cycle EUV temporal variations. Kent was also involved with the analysis of doppler shifted Lyman  $\alpha$  aurora ECOM data which yielded direct evidence and a means to study some proton aurora.

Mr. Brett Bush under the guidance of Dr. Randy Gladstone is in the process of writing a spherical radiative transport model. It utilizes the symmetry of the earth sun axis to enable a this 2d model to accurately derive optically thick emissions with scale heights comparable to the radius of the Earth: HeI 584 Å and HI 1216 Å. This will form a large part of Mr. Bush's Ph.D. dissertation.

Dr. G. Randall Gladstone performed detailed modeling of atomic nitrogen dayglow (NI 1134 and 1200Å) data obtained during two rocket flights and over the dayside half of one satellite orbit. He found that the N emission features are fit satisfactorily using standard MSIS-86 densities and temperature profiles, the existing cross sections for direct excitation of N by photoelectrons must be lowered by a factor of 2.5 in order to obtain a satisfactory fit to all three data sets, and that the existing cross sections for electron impact excitation of atomic nitrogen resulting in emission at 1134Å is too large, and must be lowered in this case by a factor of 5.0 in order to fit the data.

## List of Publications

"Magnetospheric and exospheric imaging in the extreme ultraviolet", Y. T. Chiu, R. M. Robinson, H. L. Collin, S. Chakrabarti, and G. R. Gladstone, *Geophys. Res. Lett.*, B17, 267, 1990.

"Extreme Ultraviolet Lines of HeI and OII in the Spectral Interval (500–900 Å) Observed with STP 78-1 Satellite", D. D. Cleary, R. P. McCoy, L. K. Harada, and S. Chakrabarti, *J.*

*Geophys. Res.*, submitted 1990.

"A First Look at the ASSI Ultraviolet Results", S. Chakrabarti, G. Schmidtke, H. Doll, and J.-C. Gerard, *Adv. Space Res.*, in press 1990.

"Comparative Solar EUV Flux for the San Marco ASSI", W. K. Tobiska, S. Chakrabarti, G. Schmidtke, and H. Doll, *Adv. Space Res.*, in press 1990.

"Solar EUV/UV and Equatorial Airglow Measurements from San Marco 5", G. Schmidtke, H. Doll, C. Wita, and S. Chakrabarti, *J. Atmos. and Terr. Phys.*, 53, 781, 1991.

Revised Solar Extreme Ultraviolet Flux Model, W. K. Tobiska, *J. Atmos. Terr. Phys.*, 1991.

Auroral Resonance Line Radiative Transfer, G. R. Gladstone, *J. Geophys. Res.*, 97, 1377, 1992

"Interpretation of Satellite Airglow Observations During the March 22, 1979 Magnetic Storm, Using the Coupled Ionosphere-Thermosphere Model Developed at University College, London", H. F. Parish, G. R. Gladstone, and S. Chakrabarti, *J. Geophys. Res.*, submitted, 1992.

"An Analysis of Proton Aurora Observations by P78-1," Kim, Y. H., G. R. Gladstone, and S. Chakrabarti, to be submitted to *J. Geophys. Res.*, 1992.

"An Analysis of Proton Aurora Observations by P78-1," Kim, Y. H., G. R. Gladstone, and S. Chakrabarti, to be submitted to *J. Geophys. Res.*, 1992.

"Atomic Nitrogen Dayglow Emissions Observed from the STP78-1 Satellite," Gladstone, G. R., R. Link, G. Fruth, and S. Chakrabarti, to be submitted to *J. Geophys. Res.*, 1992.

## List of Conference Reports on ECOM-721

"An Analysis of Proton Aurora Observations by P78-1," Kim, Y. H., G. R. Gladstone, and S. Chakrabarti, Fall Annual Meeting, American Geophysical Union, San Francisco, 1992.

"Resonance Line Radiative Transfer in the Aurora and Dayglow," Gladstone, G. R., (invited), 19th Annual European Meeting on Atmospheric Studies by Optical Methods, Kiruna, Sweden, August, 1992.

"Morphology of EUV Aurora: STP78-1 Observations During the March 22, 1979 Chakrabarti, S., and G. R. Gladstone, Magnetic Storm," Fall Annual Meeting, American Geophysical Union, San Francisco, 1991.

"Simulations of the March 22, 1979 Magnetic Storm Using a Coupled Parish, H. F., G. R. Gladstone, and S. Chakrabarti, Ionosphere-Thermosphere Model and Comparison With Satellite Airglow Observations," Fall Annual Meeting, American Geophysical Union, San Francisco, 1991.

"Atomic Nitrogen Dayglow Emissions Observed from the STP78-1 Satellite," Gladstone, G. R., R. Link, G. Fruth, and S. Chakrabarti, Fall Annual Meeting, American Geophysical Union, San Francisco, 1990.

"Radiative Transfer Effects in the UV Dayglow and Aurora," (invited), Gladstone, G. R., Fall Annual Meeting, American Geophysical Union, San Francisco, 1989.

## List of Participating Scientific Personnel

Below is a list of all the scientific personnel that contributed to the work described above. Also listed is each persons current institution. Note, however, that the majority of their work on this grant was performed at the University of California at Berkeley.

Prof. Supriya Chakrabarti  
Center for Space Physics  
Boston University

Dr. G. Randall Gladstone  
Space Sciences Laboratory  
University of California, Berkeley

Dr. Richard Link  
Computational Physics Inc.  
Annandale, VA

Dr. Kent Tobiska  
Jet Propulsion Laboratory  
Pasadena, CA.

Dr. Helen Parish  
Center for Space Physics  
Boston University

Dr. Daniel Cotton\*  
Center for Space Physics  
Boston University

Dr. Y.-H. Kim  
Space Sciences Laboratory,  
University of California, Berkeley

Mr. Brett Bush  
Space Sciences Laboratory,  
University of California, Berkeley

Mr. Robert Conant  
Space Sciences Laboratory,  
University of California, Berkeley

\* Received his Ph.D. in May 1991.

February 3, 1993

Henry C. Brinton  
Manager, Planetary Instrument Definition and Development Program  
Solar System Exploration Division  
Office of Space Science and Applications

Dear Dr. Brinton

We recently received the peer review report of our proposal entitled the "Boston Lightweight Imaging and Spectroscopy System (BLISS)" which we submitted in response to the PIDDP AO. After studying that document in an effort to improve our proposal preparation skills we have several questions about the reviewer's comments that we would like to bring to your attention.

The panel found that the proposal "...lacks a focus." and stated that "Specific applicability to missions would help." The system described in the proposal was intended to be widely applicable to a variety of Solar System Exploration Division (SSED) problems and was envisioned as a system which could be tailored to many different scientific goals. If the panel found this to be a weakness, we cannot object. However, since the proposal discusses three different specific applications of BLISS (BLISS on MESUR - section 3.1; BLISS on NEAR - section 3.2; and BLISS on Missions to the Outer Planets - section 3.3) we do not understand the objection that we lack "Specific applicability." In the future, how can we emphasize our applicability to SSED missions?

Among the weaknesses identified in our effort the panel cited that "The diagrams were too schematic to give an accurate impression of the experience of the proposer in the practical aspects of ...". At the same time they find that one of the strengths of the proposal is: "The PI and his group have a good track record and reputation." Furthermore, the proposal indicates (Section 2.1.1) that the instrument is an extension of a design that "...has all ready been constructed and will fly in September 1992" (which it, in fact, did on Oct 27th). Furthermore, our section entitled "Publications from prior support" (Section 4.3.1) lists a variety of instrumental papers that our group has published. The purpose of the figures was merely present a schematic layout of the instrument optical system. We had planned to use PIDDP funding to develop the hardware described. As a result detailed plans are not available. How can we alter our presentation of the optical layout of our system to demonstrate our ability to produce the optical system described?

The largest objection to the proposal seems to be the contention that "... Fig.

5 ... is a distinctly non-imaging configuration." As we described in section 2.1.4 this configuration does, in fact, image. The imaging capabilities of this system are demonstrated in figures 14 through 17. Figure 14 clearly shows an detector image with a bandpass of 550-1100Å and an imaged field of view from  $-0.9^\circ$  to  $0.9^\circ$  (for a total of  $1.8^\circ$ ). Figures 15 through 17 proceed to demonstrate that both the imaging and spectral resolution are held across the entire band and the entire field of view. As we stated in section 2.1.4, "Our optical design is quite different from the standard use of a toroidal grating .... We feel that this will be a very powerful technique." We have provided a written description of how this system works as well as a raytrace demonstrating its performance. We believe that (possibly due to our poor explanation) the reviewers failed to appreciate the new design. What additional information would the panel have liked to see in order to be convinced that the system works as we contend?

The proposal lists four BLISS operating modes. The panel's objections seem to center around the imaging spectrograph but do not discuss the other three modes. Are there any difficulties with those other three operating configurations or are the "technical deficiencies" solely with the imaging spectrograph mode?

We would like to thank you for forwarding the review panel's comments to us and appreciate your guidance as we try to improve our proposal presentation skills.

Sincerely,

Dr. Supriya Chakrabarti

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